OUR HOME--EARTH FROM SPACE

GSFC - FINAL DRAFT

Lisa Moody/Spectrum Productions

EXT. SPECTRUM PARKING LOT - DAY

Danielle is on a dolly underneath a 1950's collector car; Ray is in the foreground handing her tools as she works.

DANIELLE
(off cam)
Ray, hand me the pliers, will you?

Ray looks through the toolbox and picks up a pair of pliers.

RAY
(to cam)
Hey there! You know, there really is a lot of great science in these old cars.

Danielle pushes out from under the car as she speaks.

DANIELLE
Who are you talking to?

She seems surprised to "see" the viewer.

DANIELLE (cont'd)
(to cam)
Oh, visitors!

RAY
Danielle, I was just saying that it's not much of a leap from understanding cars to understanding Earth Science.

Danielle looks at him dubiously.

DANIELLE
And just how are they related?

Ray looks at her matter-of-factly.

RAY
Well, a car engine and Earth Science events are all parts of interrelated systems.

DANIELLE
Right. And all of their diverse parts function as a complex whole. For example, hand me that oil filter and I'll show you.

Ray hands her the oil filter.

DANIELLE (cont'd)
This oil filter doesn't do anything on its own, right? But it becomes a functional part of the car...

RAY
...or part of the system...

DANIELLE
...when you install it and turn on the ignition.

RAY
Which fires up the car and sends gas from the tank, through the engine...

DANIELLE
...and oil from the reservoir goes through the filter and into the engine and away we go. Each part is related to the whole.

RAY
But, if you were to take away or change any one of those parts...like the spark plugs, the gas, or the oil... the car wouldn't even run.

DANIELLE
Or, in the case of the oil, the car won't run very long without totally destroying the car's engine.

RAY
The same can be said about the phenomena that are part of the Earth System.

DANIELLE
Hey, Ray, will you hand me the oil filter wrench?

Ray inadvertently hands her a regular wrench, as he keeps on speaking.

Ray (cont'd)
Well, to show you what we're talking about, we're going to look at things like glaciers, El Niño, and hurricanes...

DANIELLE
Um, excuse me, Ray, but this isn't an oil filter wrench.

Ray excuses himself from the viewer.

RAY
Oh, sorry I must have grabbed the wrong wrench.

DANIELLE
The right tools are critical to completing a specific task correctly. While I finish changing this oil filter, take a look at some of the tools we use to look at Our Home - Earth from Space.

(Fade to black).

DANIELLE (VO)
Can you imagine the world without satellites? They're so much a part of our daily lives and yet, they've only been in existence for a little over 40 years. Early satellites were launched to observe weather and for navigation. But today, they're used for everything from entertainment, education, research, tracking endangered species to helping us find our way when we're lost.

DANIELLE (VO)
Satellites are made of four major components, a control base for communicating capabilities with Earth, a power source, and observing instruments. Messages sent to the satellite from the control base are called uplinks. And messages transmitted from the satellite back to Earth are downlinks. Most satellites are battery powered, and rely on the sun to recharge their batteries through large solar panels.

DANIELLE (VO)
Specialized instruments or sensors on a satellite gather data that are used by scientists. The sensors are capable of gathering a wide range of information about the Earth's atmosphere, land, and oceans. Not all satellites view visible light. Depending on the mission, measurements might be taken in the visible light range or microwave, or radar, or infrared range. Some satellites don't even face the earth but are used to study the sun, which provides almost all of the energy for our Earth system. Satellites transmit digital data to a computer on Earth, which translates the data into a useful form. Sometimes the data takes the form of a photographic image. Often satellite images are color-enhanced to make certain details stand out.

SHOW EXAMPLE OF COLOR-ENHANCED IMAGE

DANIELLE (VO)
Weather and communications satellites are positioned at a point 22,238 miles above the Earth's equator in what is called a geostationary Earth orbit. In 1945, science fiction author Arthur C. Clarke suggested that satellites placed at this altitude would rotate around the Earth in one day. Since a satellite placed at this altitude takes the same time to complete one revolution as the Earth rotates once, the satellite appears stationary above

Earth. That's why satellite dishes on the ground don't need adjusting once they've been aimed correctly at a target satellite. An added benefit for weather satellites is that at this altitude, the satellites get a full-disc view of the Earth. Because they stay above a fixed spot on the surface, they provide a constant vigil for the atmospheric "triggers" for severe weather conditions such as tornadoes, flash floods, hail storms and hurricanes.

Other satellites orbit the Earth in less time. As these satellites pass over different locations on the Earth, they take measurements that paint a picture of the patterns over the entire globe. The difference between a geostationary and an orbiting satellite is the difference between seeing one point on the Earth all the time, compared to seeing the entire Earth, over a long period of time from closer up. Scientists study the Earth using both geostationary and orbiting satellites.

Satellites: An essential tool for viewing our home. They look down on us from space, but guess what...it's a two-way street, so to speak. On a clear night, especially near dawn and dusk, check out how many orbiting satellites you can see in the sky. Even though you're in darkness, a satellite passing overhead may still be in the sunlight. Light reflecting off of the satellite may be bright enough to illuminate the satellite for us to see as it passes overhead.

EARTH FACT regarding satellites -

Most satellites orbit the earth at an altitude between 250 and 450 miles. At that altitude, a satellite needs to be traveling at approximately 18,000 miles per hour to maintain its orbit.

EXT. SEAWORLD PACIFIC POINT - DAY

Danielle and Ray are feeding sea lions at Pacific Point exhibit.

RAY
Communication satellites, weather satellites, Earth observing satellites, and manned space flights, give us a lot of information that provides the answers to some pretty tough questions.

DANIELLE
(inquisitively)
For example...?

RAY
Like, why we need more volunteers at marine mammal aquariums throughout the United States during El Niño years.

DANIELLE
I don’t see the connection.

RAY
Danielle, you wouldn’t believe how much everything is tied together.

DANIELLE
I understand that, but how can an event that starts somewhere in the Pacific Ocean affect volunteers in the U.S.?

RAY
Watch...

Segue to B-roll and VO of El Niño images pertinent to dialogue.

RAY (VO)
El Niño is an ocean event that has far reaching consequences. The disruption of ocean-atmosphere systems affects weather around the globe. It usually increases rainfall across the southern U.S., often causes flooding in Peru, and drought in the West Pacific, which

can lead to devastating brush fires in Australia. El Niño means "The little boy", or "Christ Child" in Spanish. It originally referred to a warming of the ocean waters along the coast of Ecuador that occurs around Christmas every year. Now the term is used a little differently, referring only to much larger warmings that occur across the entire tropical Pacific Ocean, and not necessarily arriving at Christmas time.

RAY

During normal years, the Trade Winds blow from east to west across the tropical Pacific. These winds cause warm water to pile up in the western Pacific, so the sea surface is about five feet higher near Indonesia than it is at Ecuador. The sea surface temperature is about 14 degrees Fahrenheit warmer in the west with cooler temperatures off the coast of South America. [This is due to an upwelling of cold water in the east from deeper levels which replaces the warm surface water which is forced away by the action of the wind.] This colder water is high in nutrients, providing food and excellent conditions for growth of ocean plants. They, in turn, are food for sea animals to eat.

RAY

Now, during an El Niño, the Trade Winds weaken and can even reverse direction in the central and western Pacific. This, in a sense, shuts off the natural air conditioning by preventing the colder nutrient-rich water from upwelling. The result is a rise in sea surface temperature along the coast of Peru. These waters aren't as nutrient-rich as the colder waters, and this starts an adverse reaction that moves all the way up the food chain. Without nutrients, the plants don't reproduce so there isn't enough of them for the animals to feed on. Or, it can force animals, fish, and birds to migrate to other areas in search of food. This

can cause imbalances in the food chain in new areas.

RAY
This is what happens in the ocean. But the spin-off effects of El Niño alter the weather over land, bringing heavy rains and flooding to some areas, and severe drought to others. With either of these situations, the food chain is thrown out of balance. Whenever nature is altered in a dramatic way, human lifestyle is also altered. There is evidence of food shortages worldwide during recent El Niño events. Also, flu and other viruses, as well as allergies to certain molds and pollen increase significantly during El Niños. You can see how important it is to be able to predict an El Niño. Satellite technology is one tool that nations around the world are learning to use to help them prepare for El Niño and it's affects.

EXTERNAL SEAWORLD PACIFIC POINT - DAY

DANIELLE
Ray, that was an excellent overview but what does that have to do with an increase in volunteerism?

RAY
Ahh… That's a great question, Danielle, sometimes you've got to think just a little bit outside the box. Give it a try.

Cut to video.

DANIELLE
OK, let me think. (VO) You talked about the changes in the ocean during El Niño and how that affects the food chain. I'm supposed to connect that to a greater need for volunteers at sea mammal aquariums. I got it! With alterations in the food chain, there are more distressed sea mammals.

RAY
Right, so it takes more people volunteering for rescue and rehabilitation of sick or stranded animals.

Ray (to audience)
There are major connections. Look beyond the obvious!

EARTH FACT

Although it's known that weakening Trade Winds signal the beginning of an El Niño, the cause of this phenomenon remains unknown. Satellite data as well as data collected by ocean-moored buoys and models are used to try to discover the cause of El Niño.

INT. SEAWORLD WILD ARCTIC POLAR BEARS - DAY

DANIELLE
OK, I see what you're doing. You mentioned that a natural phenomenon like El Niño might increase the occurrence of certain diseases.

RAY
Right...go on...

DANIELLE
Well, glacial ice may also be connected to some of the same diseases.

RAY
You mean, like glacial ice might be connected to mosquitoes...?

DANIELLE
Ice and mosquitoes — good connection, Ray. Check this out.

Segue to video.

DANIELLE
Glaciers exist on all of the continents except Australia. Mountain glaciers in particular, are

very sensitive indicators of climate change. Accumulation of snow and ice are called input, increasing the mass of the glaciers. Melting and calving, which is when a big chunk of ice breaks off the main glacier, are known as output, and it decreases a glacier's mass. Many things affect the balance between input and output. For example, temperature, precipitation, humidity, wind speed, slope and reflectivity are all factors that can affect this balance. So, as climate changes, the relationship between input and output also changes. This can alter the thickness of the glacier and its advance or retreat. But most glaciers are more sensitive to air temperature than anything else.

DANIELLE

You've heard of global warming? This is a global increase in atmospheric temperature that many scientists believe is caused by an increase in heat-trapping gases in the atmosphere. These gases are sometimes called greenhouse gases because they trap heat in the atmosphere just like the glass in a greenhouse keeps the heat inside the greenhouse from escaping. Some of this increase in greenhouse gases is probably natural but some human activities seem to be enhancing the effect. For instance, through fossil fuel use, an increase in the release of heat-trapping gases could lead to global warming, which in turn could lead to glacial melting and there is evidence of melting. Data suggest that since 1850 some Alpine glaciers have lost between 30 to 40% of their surface area and about 50% of their volume. Similar findings have been reported in other glaciers around the world. Global compilations show that sea level has risen by about one tenth of an inch per year. That may not sound live much, but by the year 2100, sea level may rise by almost two feet, if this warming trend continues.

DANIELLE

Ice serves many functions. During the Arctic winter, the air is colder than the water. The ice helps to insulate the water from the atmosphere. Where there is no ice, there's a huge heat flow from the water to the atmosphere, which causes the air temperature to go up. Ice also restricts the energy of the wind from causing waves near the ice. That's why ships often stay near the ice, where the seas are calmer. Ice also acts as a mass exchange, preventing ocean water from evaporating into the atmosphere, and, since ice is white, it reflects the sun's energy, keeping the system cool. Without ice, the temperature of the Earth would likely increase, perhaps significantly. Even a modest rise of two to four degrees Fahrenheit could have a profound effect. Some regions of the world might experience more rainfall, leading to floods that would impact agriculture and forest growth. Fertile wetlands could be lost due to rises in sea level, and low-lying areas might experience flooding from melting water runoff. Warmer temperatures in moist areas of the world could become fertile breeding grounds for mosquitoes and other disease transferring organisms so, we could see malaria in areas of the world where it has never before existed.

INTERIOR AT SEAWORLD WILD ARCTIC POLAR BEARS - DAY

RAY

But you know, Danielle, there are things we can do everyday to help protect our planet from global warming.

Montage of quick shots: Danielle & Ray together drive by in car, walking down street, on a bicycle, standing near a bus stop sign. Replacing light bulb in a lamp. Installing a showerhead, caulking a window, checking the strip on a refrigerator, and planting a tree.

DANIELLE
All those things can make a difference, but the best way to help is to cut down on fossil fuel use. You could carpool, walk, bike, walk, use public transit...

RAY
...And, plant a tree. They absorb a lot of carbon dioxide-one of the greenhouse gases.

DANIELLE
And, like you said before, look beyond the obvious. Sometimes even the smallest things can make a difference.

EARTH FACT

Reduce, Reuse and Recycle! Making paper, glass and metal products from recycled materials saves 70 - 90% of the energy and pollution that would result if the product came from original materials!

INTERIOR FLORIDA AQUARIUM CORAL EXHIBIT - DAY

Ray and Danielle are at the exhibit.

DANIELLE
So far we've checked out a natural occurrence like El Niño...

RAY
...And global warming. We've seen how El Niño can cause increased precipitation in some areas and how both phenomena can relate to flooding and even drought.

DANIELLE
And that's what we're going to look at next...drought and its connections.

RAY
(to cam)

So, you're probably wondering why we're standing in front of a wall of water getting ready to talk about such a dry subject…

DANIELLE
but then again, you're probably already looking beyond the obvious.

Segue to video.

RAY
Drought, like other phenomena in the Earth System, has obvious local impacts. The most famous dry period in the United States' history is the 1930's drought in the Great Plains. That area was referred to as the "Dust Bow" and the drought lasted a decade. It's estimated that by the end of the 10-year span, financial assistance from the government may have been as high as $1 billion in 1930's dollars. ($12,444,917,999 in year 2000) But drought causes more than economic devastation. It produces a complex web of impacts that can touch our lives environmentally and socially, as well as economically.

RAY
Drought increases the risk of fire. During recent droughts, we've seen the destruction of forestland, wildlife and homes. Satellite imagery shows the far-reaching effects of soot and ash from these fires, as they get caught up in the winds. Fires have an impact on air quality thousands of miles away.

There are other ways that the atmosphere spreads the effects of a local event. For example, take a human-initiated activity like cattle farming in Africa. Due to over-grazing, there's more dust produced. Add to this a drought, possibly linked to a change in weather as a result of, say, El Niño. Now you've got dust on top of dust! When the wind blows, dust from Africa gets caught in the Trade Winds and blows westward over the Atlantic

Ocean. This dust has been found in the Caribbean, and is considered a leading suspect in the death of sea fans in the coral reefs. Amazing what you can find if you look beyond the obvious.

EARTH FACT
Studies suggest that Saharan dust may play a role in determining the frequency and intensity of hurricanes formed in the eastern Atlantic Ocean.

INTERIOR HURRICANE CHAMBER

DANIELLE
You know, there's another phenomenon that starts in Africa and affects the Caribbean and the United States.

Ray pushes his way against the force of the wind.

RAY
Let me guess what that would be...You wouldn't happen to be talking about hurricanes, would you?

DANIELLE
(excitedly)
The wind in this hurricane simulator reaches up to speeds of 85 miles per hour. That's equivalent to a class 1 hurricane.

RAY
I don't know about you, but rather see hurricanes from up above. Come on, let's get out of here.

Ray and Danielle exit the shot.

DANIELLE
Most tropical hurricanes have their beginnings in disturbances known as African easterly waves, since they originate over North Africa The waves are convectively active, that is, they usually contain thunderstorms. As they move west across the Atlantic Ocean, some of them grow into hurricanes during the summer. The hurricane season lasts from June to November.

During strong El Niños, there are practically no hurricanes.

DANIELLE
In order for hurricanes to develop, the thunderstorms, or convective areas, need to reach high into the atmosphere. As high as 10 miles! One of the effects of an El Nino is to displace the very fast moving air in the atmosphere, known as the jet stream, right over the areas where the hurricane usually develops. This fast moving air blows the tops right off these thunderstorms so that they never reach high enough in the atmosphere for a full-blown hurricane to develop. We talked a lot about some of El Nino's bad consequences, but it does have its good points. Limiting hurricanes in the Atlantic is one of them.

EARTH FACTOID

From World War II through 1979, hurricanes ere informally named after the girlfriends and wives of U.S. Army Air Corp and Navy meteorologists monitoring and forecasting tropical cyclones over the Pacific.

EXTERIOR DRIVEWAY - DAY

RAY
And so, we've come full-circle. El Niño, a Pacific Ocean phenomenon, affects events far away like hurricanes in the Atlantic Ocean and drought in Africa..

DANIELLE
But, if you think about it, that's the case in everything we've looked at today. I think the message is that all parts of a system are connected in obvious and sometimes not so obvious ways.

RAY
And, the impacts can be direct or indirect. Like, during El Niño, less farming occurs in

South America along the equator due to a less rainfall.

DANIELLE
So the farm workers that usually tend to the crops have to find another line of work so that they can take care of their families.

Danielle pushes herself underneath the car to finish the oil change, as Ray continues to talk.

RAY
These temporarily out of work farm workers turn to clearing the tropical rain forest to make way for expanding farms. They clear the way by burning back the forests, entering more smoke particles and carbon dioxide into the air. It's clear that there are major connections all around us. You just have to look beyond the obvious!

DANIELLE
Hey, Ray, I'm finished with this oil change. Care to join me for a soda? You're buying.

Danielle glides out from underneath the car. Ray smiles into the camera.

RAY
I'm way ahead of you. Here you go… (Gives Danielle a can of soda.)

DANIELLE
Thanks! Gosh, it's so hot out here…